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PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

April 26, 1996

Captain Ed Marchand
AFCEE/ERT
8001 Arnold Drive
Brooks AFB, Texas 78235-5357

Subject: Results of Soil Gas Sampling at the Building U-3 Petroleum, Oils, and Lubricants (POL) Site, Camp Ripley, Minnesota

Dear Captain Marchand:

This letter report contains the results of an initial soil gas characterization performed by Parsons Engineering Science, Inc. (Parsons ES) at the subject site on 27 March 1996. The initial soil gas characterization was performed after a meeting held on 26 March 1996 at Camp Ripley to initiate Option 3 bioventing pilot testing under the AFCEE Extended Bioventing Project (Contract F41624-92-D-8036, Delivery Order 17). I attended this kickoff meeting, along with Mr. Jim Gonzales of AFCEE/ERT, Mr. Gene Fabian of the US Army Environmental Center (USAEC), Mr. Larry Rainey and Mr. John Ebert of the Minnesota Department of Military Affairs, and Ms. Sandra Miller-Moren and Mr. Brad Nordberg of the Minnesota Pollution Control Agency.

## Background

The Building U-3 POL Site is a former truck service area where fuels were stored and dispensed. Tank removal, subsurface investigation activities, and corrective action design at the site were performed by Wenck Associates, Inc. (Wenck), of Maple Plain, Minnesota. The following background information has been summarized from a report entitled *Remedial Investigation/Corrective Action Design Report, Camp Ripley, Building U-3 POL* (Wenck, May 1994). One 10,000-gallon diesel fuel underground storage tank (UST), one 10,000-gallon gasoline UST, one 5,000-gallon gasoline UST, and a dispenser pump island that formerly existed at the site were removed in 1992. The 5,000-gallon UST and the product piping associated with the dispenser pump island are believed to be the primary sources of contamination at this site. Tank and dispenser pump island locations are illustrated in Figures 7 and 8 of the Wenck report, included in Attachment A to this letter.

Numerous soil borings, groundwater monitoring wells, and wells for soil vapor extraction (SVE) and air sparging pilot testing were installed to characterize the hydrogeologic conditions and to define the extent of petroleum hydrocarbon contamination at the site. Figures 7 and 8 in Attachment A illustrate the locations of these wells and soil borings, along with estimated extents of soil and groundwater

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20001122 040

contamination, respectively. A hydrogeologic cross-section (Figure 4 from the Wenck report) and soil and groundwater analytical results (Wenck Tables 2 and 3) are also included in Attachment A. Soil boring logs and well construction diagrams have been included as Attachment B.

Soils at the site consist primarily of medium-grained sands. Groundwater occurs at a depth of approximately 18 feet below ground surface, and flows to the east-southeast at a gradient of approximately 0.002 foot/foot. Petroleum-contaminated soil appears to be limited to a "smear zone" corresponding with the groundwater table. Water level information obtained from Camp Ripley on April 25, 1996 strongly suggests that the "smear zone" contamination has been entirely underwater for the past 2 1/4 years (Attachment C). Benzene and total petroleum hydrocarbons (TPH) as gasoline-range organics (GRO) have been detected in "smear zone" soils at concentrations as high as 4.5 milligrams per kilogram (mg/kg) and 1,000 mg/kg, respectively. Fuel-related contamination in shallower soils was negligible. Benzene concentrations in groundwater were as high as 570 micrograms per liter (µg/L) in an October 1993 sampling event, and the groundwater contaminant plume is approximately 500 feet long by 300 feet wide, as defined by the 10 µg/L benzene isopleth.

Wenck performed SVE and air sparging pilot testing in March 1994 following the site investigation. The SVE pilot test was conducted for 1 day at flow rates ranging from 25 to 133 standard cubic feet per minute (scfm). Soil gas extracted during the pilot test was not significantly contaminated. Volatile hydrocarbons were detected at a maximum concentration of 116 parts per million, volume per volume (ppmv) during the pilot test. The air sparging pilot test was also conducted for 1 day at flow rates ranging from 6 to 101 scfm. Dissolved oxygen (DO) was not detected in fuel-contaminated groundwater prior to the air sparging pilot test, indicating the occurrence of aerobic fuel hydrocarbon biodegradation in the saturated zone.

**Initial Soil Gas Characterization**

In March 1996, soil gas samples were collected from all accessible wells in the soil contamination source area to characterize subsurface conditions and to determine if the site was a candidate for remediation using *in situ* bioventing. The wells were purged, and initial oxygen, carbon dioxide, and total volatile hydrocarbon (TVH) concentrations were measured using portable gas analyzers, as described in the document entitled *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (Hinchee *et al.*, 1992). Soil gas oxygen and carbon dioxide levels were measured to determine if aerobic hydrocarbon biodegradation is occurring in vadose zone soils. If oxygen is depleted (below 5 percent) and carbon dioxide concentrations are elevated in soil gas drawn from fuel-contaminated soil, then aerobic hydrocarbon biodegradation likely is occurring and is limited by available oxygen. Bioventing can therefore be used to provide oxygen to fuel-contaminated soil and to stimulate the naturally occurring biodegradation of petroleum hydrocarbons. If TVH concentrations are elevated in soil gas [above approximately 5,000 parts per million, volume per volume (ppmv)], emissions of volatile hydrocarbons to the surface may be a concern

with an air-injection remedial option, and SVE may be a more appropriate low-cost option for remediation of vadose zone soils.

Table 1 (below) summarizes the initial soil gas chemistry at the site. Oxygen was present at elevated concentrations, ranging from 19.8 to 20.7 percent. Also, carbon dioxide was present at low concentrations, ranging from 0.3 to 1.5 percent. It appears that sufficient oxygen concentrations are already present to support aerobic biodegradation of the remaining fuel residuals in the vadose zone soils at the site. Initial TVH concentrations in soil gas ranged from 31 to 195 ppmv. These are near-background concentrations. It appears that any volatile fuel hydrocarbon contamination in the vadose zone has either naturally biodegraded or was substantially removed during the earlier SVE pilot testing performed by Wenck.

**TABLE 1**

**INITIAL SOIL GAS CHEMISTRY**

**BUILDING U-3 POL SITE**

**27 MARCH 1996**

| Well | Time of Sample Collection | Oxygen (%) | Carbon Dioxide (%) | TVH (ppmv) |
|---|---|---|---|---|
| EV-1 | 1055 | 20.4 | .95 | 140 |
| MW-2 | 1011 | 19.8 | 1.5 | 195 |
| MW-3 | 1117 | 20.7 | 0.3 | 38 |
| MW-4 | 1200 | 20.6 | 0.3 | 31 |
| MW-5 | 0948 | 20.3 | 0.7 | 115 |

## Conclusions

The results of this soil gas sampling event indicate that there is very little volatile petroleum contamination remaining in vadose zone soil at this site, and that vadose zone remediation using either SVE or bioventing is unnecessary. Parsons ES recommends the reallocation of the Option 3 to a more appropriate site.

A plume of groundwater BTEX contamination exists at the site, but it does not appear to be mobile, based on long-term groundwater monitoring conducted by Camp Ripley. A risk-based approach using intrinsic remediation under Minnesota's risk-based corrective action guidelines may be the most appropriate option for achieving regulatory action levels for groundwater at this site.

If you have any questions about this sampling effort or need further information about risk-based corrective action or intrinsic remediation please call me or Doug Downey at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

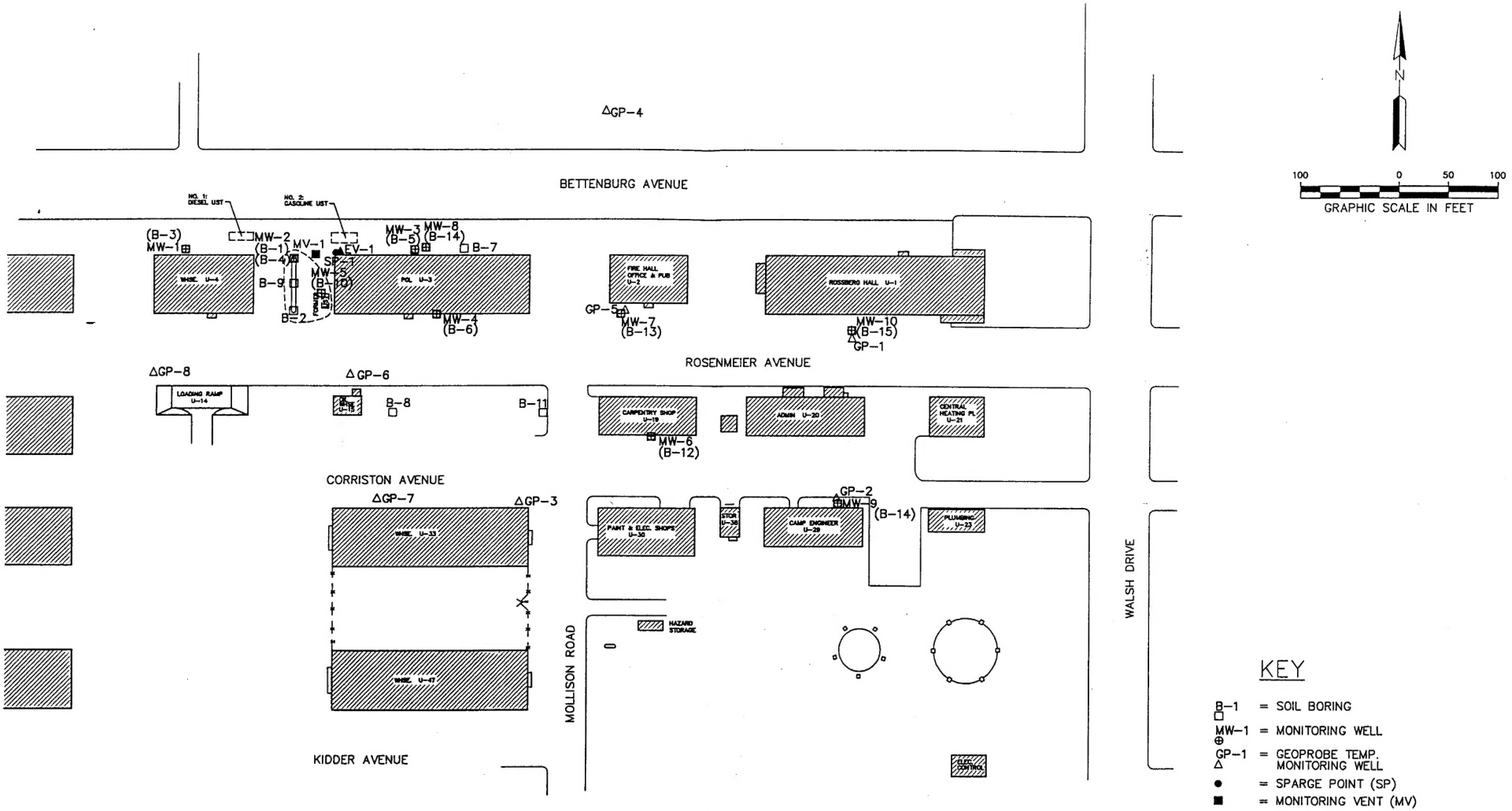
John Ratz, P.E.
Project Manager

cc: Mr. Gene Fabian, USAEC
Mr. Jim Gonzales, AFCEE/ERT
Mr. Larry Rainey, State of Minnesota Department of Military Affairs

Attachments: A - Tables and Figures
B - Soil Boring Logs and Well Construction Diagrams
C - Groundwater Elevations and Estimated "Smear Zone" Elevation

# ATTACHMENT A

# TABLES AND FIGURES
# (WENCK, MAY 1994)




## KEY

- B-1 = SOIL BORING
- MW-1 = MONITORING WELL
- GP-1 = GEOPROBE TEMP. MONITORING WELL
- = SPARGE POINT (SP)
- = MONITORING VENT (MV)
- = EXTRACTION VENT (EV)
- (B-1) = SOIL BORINGS COMPLETED AS WELLS
- = EXTENT OF SOIL CONTAMINATION

| | |
|---|---|
| FILE | MAF05044.DWG |
| DATE | 5-6-94 KBW |

MINNESOTA ARMY NATIONAL GUARD

Camp Ripley – Building U-3 POL
Limits of Soil Contamination

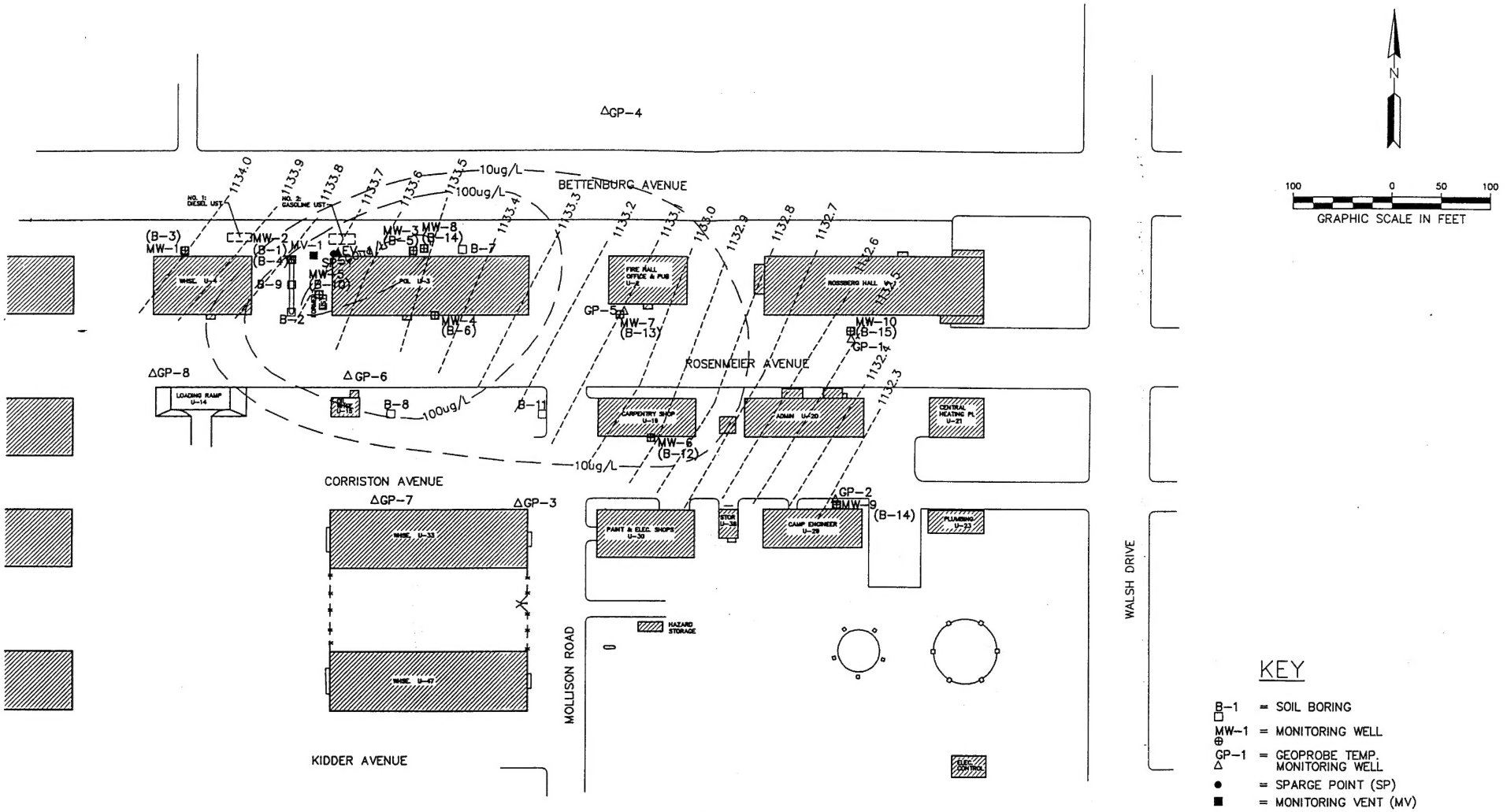


Wenck

Wenck Associates, Inc.
Environmental Engineers
1800 Pioneer Creek Center
Maple Plain, MN 55359

MAY 1994

Figure No. 7




## KEY

- B-1 = SOIL BORING
- MW-1 = MONITORING WELL
- GP-1 = GEOPROBE TEMP. MONITORING WELL
- = SPARGE POINT (SP)
- = MONITORING VENT (MV)
- = EXTRACTION VENT (EV)
- (B-1) = SOIL BORINGS COMPLETED AS WELLS
- 86.50 = GROUNDWATER ELEVATIONS (NOV. 23, 1993)
- 10UG/L = BENZENE ISOCONCENTRATION CONTOURS

FILE MAF04044.DWG
DATE 5-2-94 KBW

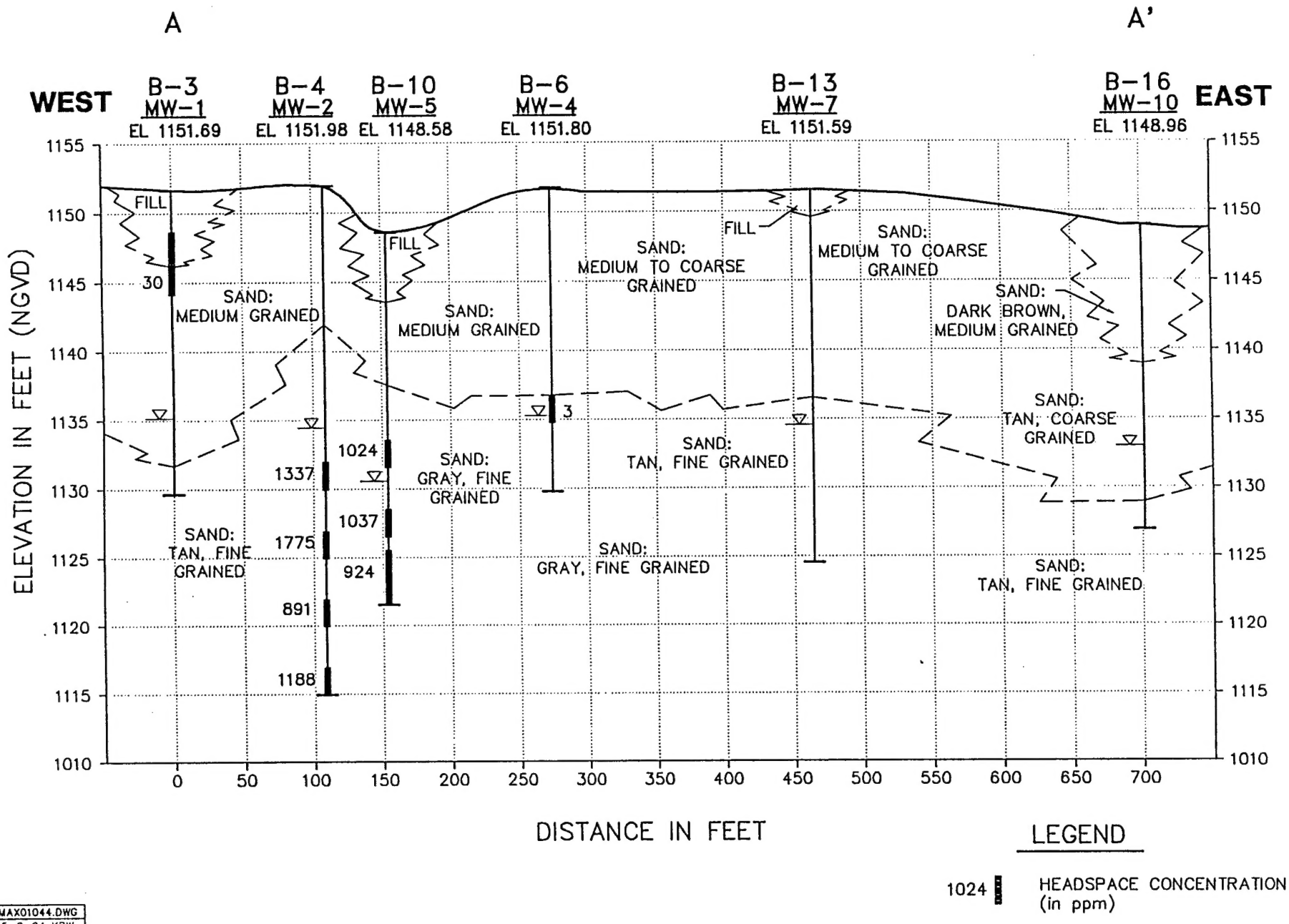
MINNESOTA ARMY NATIONAL GUARD

Camp Ripley – Building U-3 POL
Limits of Groundwater Contamination


Wenck Associates, Inc. Environmental Engineers
1800 Pioneer Creek Center Maple Plain, MN 55359

MAY 1994

Figure No. 8

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MINNESOTA ARMY NATIONAL GUARD

Camp Ripley - Building U-3 POL
Cross-Section A-A'



Wenck

Wenck Associates, Inc. 1800 Pioneer Creek Ctr.
Environmental Engineers Maple Plain, MN 55359

MAY 1994

Figure 4

## TABLE 2

### Soil Sample Laboratory Analytical Results
### Camp Ripley - Building U-3 POL

| Soil Boring | Depth (ft) | Date | TPH as DRO (mg/kg) | TPH as GRO (mg/kg) | TPH as Gasoline (mg/kg) | TPH as #2 Fuel oil (mg/kg) | Methyl tert-butyl ether (ug/kg) | Benzene (ug/kg) | Toluene (ug/kg) | Ethyl benzene (ug/kg) | m,p Xylenes (ug/kg) | o-Xylene (ug/kg) | Total Xylene (ug/kg) | Lead (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tank 1 East | | 11-6-92 | NA | NA | <0.60 | <0.80 | NA | NA | NA | NA | NA | NA | NA | NA |
| Tank 1 West | | 11-6-92 | NA | NA | <0.60 | <0.80 | NA | NA | NA | NA | NA | NA | NA | NA |
| Tank 2 East | | 11-6-92 | NA | NA | <0.60 | <0.80 | <7.5 | <5.0 | <5.0 | <5.0 | NA | NA | 14 | <7.5 |
| Tank 2 West | | 11-6-92 | NA | NA | <0.60 | <0.80 | <7.5 | <5.0 | <5.0 | <1.0 | NA | NA | <10 | NA |
| B-2 | 17-19 | 5-10-93 | 490[1] | NA | NA | NA | NA | 4,500 | 55,000 | 16,000 | NA | NA | 88,000 | NA |
| B-7 | 18-20 | 6-10-93 | <4.0 | <1.0 | NA | NA | <200 | <100 | <100 | <100 | <100 | <100 | NA | <3.4 |
| B-8 | 15-17 | 6-10-93 | <4.0 | <1.0 | NA | NA | <200 | <100 | <100 | <100 | <100 | <100 | NA | <3.4 |
| B-9 | 5-7 | 8-11-93 | NA | 33 | NA | NA | <500 | <100 | <100 | <100 | <100 | <100 | NA | 8.5 |
| B-10 | 15-17 | 8-11-93 | NA | 1,000 | NA | NA | <500 | <100 | 6,000 | 13,000 | 51,000 | 14,000 | NA | 7.7 |
| B-11 | 25-27 | 8-11-93 | NA | <1 | NA | NA | <500 | <100 | <100 | <100 | <100 | <100 | NA | 18 |

Note:

1=Contains product which elutes outside the retention time provided by the DRO standard.
NA=Not Analyzed

## TABLE 3

### Groundwater Sample Laboratory Analytical Results
### Camp Ripley - Building U-3 POL

| Monitoring Well | Date | TPH as DRO (mg/L) | TPH as GRO (mg/L) | Benzene (ug/L) | Ethyl-benzene (ug/L) | Toluene (ug/L) | Total Xylenes (ug/L) | Methyl tert butyl ether (MTBE) (ug/L) | 2-Methyl-butene[2] (ug/L) | Ethyl ether (ug/L) | Chloroform (ug/L) | Tetrahydra-furan (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAL | | -- | -- | 10 | 700 | 1,000 | 10,000 | -- | 700 | 1,000 | 60 | 100 |
| B-9 | 11-Aug-93 | NA | NA | <400 | 1300 | 6400 | 8100 | <2,000 | 39,000 | <2,000 | <30 | <2,000 |
| MW-1 | 15-Jun-93 | <0.1 | <5 | <5 | <5 | <5 | <10 | <1 | <20 | <20 | <5 | <20 |
| | 08-Oct-93 | -- | <0.1 | 1.6 | <1.0 | <1.0 | <2.0 | <5 | -- | -- | -- | -- |
| MW-2 | 15-Jun-93 | 32[1] | 28 | 18 | 600 | 1,500 | 1390 | | <20 | <20 | <5 | <20 |
| | 08-Oct-93 | -- | 6.5 | 110 | 62 | 530 | 940 | <250 | -- | -- | -- | -- |
| MW-3 | 15-Jun-93 | 1.2[1] | 5 | 170 | 180 | 120 | 88 | | <20 | <20 | <5 | <20 |
| | 08-Oct-93 | -- | 6 | 560 | 310 | 300 | <140 | <250 | -- | -- | -- | -- |
| MW-4 | 15-Jun-93 | 4.1[1] | 9.8 | 34 | 240 | 86 | 500 | | <20 | <20 | <5 | <20 |
| | 08-Oct-93 | -- | 6.8 | 150 | <50 | 170 | <380 | <250 | -- | -- | -- | -- |
| MW-5 | 17-Aug-93 | -- | 0.4 | 520 | 420 | 1,500 | 2360 | <200 | 20,000 | 2100 | <38 | <200 |
| | 08-Oct-93 | -- | 32 | 570 | 310 | 1,700 | 2130 | <8 | -- | <16 | <8 | <40 |
| MW-6 | 17-Aug-93 | -- | 0.7 | 12 | 5.0 | 2.1 | 3.4 | <2 | 380 | <20 | <0.03 | <2 |
| | 08-Oct-93 | -- | 0.4 | 14 | 4.3 | 3.3 | <2.2 | 9.5 | -- | -- | -- | -- |
| MW-7 | 17-Aug-93 | -- | 1.4 | 35 | 8.9 | 12 | 12.3 | <2 | 1700 | 100 | 0.40 | <2 |
| | 08-Oct-93 | -- | 1.9 | 21 | 19 | 6.5 | 13.2 | 58 | -- | <4 | <2 | <2 |
| MW-8 | 17-Aug-93 | -- | <0.1 | <0.4 | <0.4 | 0.36 | <2 | <2 | <20 | <2 | 13 | <2 |
| | 08-Oct-93 | -- | <0.1 | <1.0 | <1.0 | <1.0 | <2.0 | <5 | -- | -- | -- | -- |
| MW-9 | 08-Oct-93 | -- | <0.1 | <0.40 | <1.0 | <1.0 | <2.0 | <2 | <2 | <2 | <0.03 | <2 |
| MW-10 | 08-Oct-93 | -- | 0.2 | 0.9 | 0.4 | 0.36 | <2 | <2 | <2 | <20 | <0.03 | 35 |

NOTE:
1: Contains product which elutes outside the retention window provided by the DRO standard (see Appendix C).
2: Compound mis-identified as Acetone

## TABLE 3

### Groundwater Sample Laboratory Analytical Results
### Camp Ripley - Building U-3 POL

| Monitoring Well | Date | Tetrachloro-ethene (ug/L) | Styrene (ug/L) | Isopropyl-benzene (ug/L) | n-Propyl benzene (ug/L) | 1,3,5-Tri methyl benzene (ug/L) | 1,2,4-Tri methyl benzene (ug/L) | sec-Butyl benzene (ug/L) | 4-Isopropyl toluene (ug/L) | n-Butyl benzene (ug/L) | Naphthalene (ug/L) | Lead (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAL | | 7 | 10 | 300 | -- | -- | -- | -- | -- | -- | 30 | 20 |
| B-9 | 11-Aug-93 | <40 | <40 | <500 | <2,000 | <2,000 | 2,500 | <50 | <500 | 590 | 1000 | 32 |
| MW-1 | 15-Jun-93 | <1 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <2.5 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-2 | 15-Jun-93 | <5 | <5 | 65 | 76 | 100 | 35 | 8.8 | 45 | <5 | 380 | 3.3 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-3 | 15-Jun-93 | <5 | <5 | 20 | 19 | 36 | 21 | <5 | 8.4 | <5 | 64 | <2.5 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-4 | 15-Jun-93 | <5 | <5 | 50 | 50 | 100 | 260 | 7.5 | 40 | <5 | 150 | <2.5 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-5 | 17-Aug-93 | <4 | <40 | 78 | <200 | <200 | 670 | <5 | <50 | 95 | 180 | 37 |
| | 08-Oct-93 | <8 | <8 | 54 | 55 | 600 | 590 | <8 | 75 | <8 | 170 | 12 |
| MW-6 | 17-Aug-93 | <0.4 | 0.43 | 2 | <2 | <2 | <0.4 | <0.05 | 0.54 | 2.5 | 4.8 | 23 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2.8 |
| MW-7 | 17-Aug-93 | <0.04 | 1.5 | 5.2 | <2 | <2 | 1 | <0.05 | 2.5 | 4.3 | 6.5 | <5 |
| | 08-Oct-93 | <0.4 | 2.6 | 9.3 | <2 | 10 | <2 | <2 | 2.6 | <2 | 11 | -- |
| MW-8 | 17-Aug-93 | <0.04 | <0.04 | <0.05 | <0.2 | <0.2 | <0.4 | <0.5 | <0.05 | <0.5 | 0.36 | <5 |
| | 08-Oct-93 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-9 | 08-Oct-93 | 0.42 | <0.04 | <0.05 | <0.2 | <0.2 | <0.04 | <0.05 | <0.05 | <0.05 | <0.03 | 13 |
| MW-10 | 08-Oct-93 | <0.04 | <0.4 | <0.5 | <0.2 | <0.2 | <0.4 | <0.5 | <0.5 | <0.5 | 3.4 | <2.5 |

NOTE:
1: Contains product which elutes outside the retention window provided by the DRO standard (see Appendix C).
2: Compound mis-identified as Acetone

# ATTACHMENT B

# SOIL BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-1

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | FILL | SAND: TAN-DK.BROWN, MED.-COARSE GRAINED, DAMP | 0.0 | SS | | 4.8 |
| | | | 2.0 | SS | | 129 |
| | | | 4.0 | SS | | 11 |
| | SM | SAND: TAN-DK.BROWN, FINE-MEDIUM GRAINED, WELL SORTED. | 6.0 | SS | | 0 |
| | | | 8.0 | SS | | 0 |
| | | | 10.0 | SS | | 0 |
| | | | 12.0 | SS | | 763 |
| | | | 14.0 | SS | | 710 |
| | SM | SAND: GRAY, FINE, POORLY SORTED | 16.0 | | | |
| | | | 18.0 | | | |
| | | | 20.0 | | | |
| | | EOB @ 21.5'. | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 21.5 FT
DRILLING DATE: 5-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TWIN CITY TESTING, INC.
DRILLER: DALE DUSCHER
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 18 FEET

FILE ANCRB103.DWG
DATE 10-20-93 DLM

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-2

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | FILL | SAND: MEDIUM BROWN, MEDIUM GRAINED, POORLY SORTED | 0.0 | SS | | 45 |
| | | | 2.0 | SS | | 97 |
| | | | 4.0 | SS | | 75 |
| | | | 6.0 | SS | | 7 |
| | SP | SAND: TAN-LT.BROWN, MEDIUM GRAINED, POORLY SORTED. | 8.0 | SS-PLUGGED/NO SAMPLE | | - |
| | | | 10.0 | SS | | 2 |
| | | | 12.0 | SS | | 0 |
| | SP | SAND: TAN, FINE GRAINED, SILTY, POORLY SORTED. | 14.0 | SS | | 787 |
| | SP | SAND: GRAY, FINE GRAINED, SILTY, POORLY SORTED. | 16.0 | | | |
| | | EOB @ 19'. | 18.0 | | | |
| | | | 20.0 | | | |
| | | | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 19 FT
DRILLING DATE: 5-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TWIN CITY TESTING, INC.
DRILLER: DALE DUSCHER
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 17 FEET

| FILE | ANCRB203.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-3 (MW-1)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | FILL | SAND: DK.BROWN, FINE-MED. GRAINED. | 0.0 | SS-PLUGGED/NO SAMPLE | | - |
| | | | 2.0 | | | |
| | | | 4.0 | SS | | 30 |
| | SP | SAND: TAN, MEDIUM GRAINED, SUBANGULAR, POORLY SORTED. | 6.0 | SS | | 0 |
| | | | 8.0 | | | |
| | | | 10.0 | SS | | 0 |
| | | | 12.0 | | | |
| | | | 14.0 | | | |
| | | | 16.0 | SS | | 0 |
| | | | 18.0 | | | |
| | SW | SAND: TAN, FINE-MEDIUM GRAINED, ANGULAR, WELL SORTED. | 20.0 | SS | | 0 |
| | | EOB @ 21.4'. | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 21.4 FT
DRILLING DATE: 6-09-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 16.5 FEET

| FILE | ANCRB303.DWG |
|---|---|
| DATE | 04-14-94 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-4 (MW-2)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | | | 0.0 | | | |
| | | | | NO SAMPLE(NEW FILL) | | |
| | | | 2.0 | | | |
| | | | | | | |
| | | | 4.0 | | | |
| | SP | SAND: TAN-MED BROWN, MEDIUM GRAINED, SUBANGULAR-SUBROUND, POORLY SORTED. | | SS | | 0 |
| | | | 6.0 | | | |
| | | | | | | |
| | | | 8.0 | | | |
| | | | 10.0 | SS | | 0 |
| | | | 12.0 | | | |
| | | | | | | |
| | SP | SAND: BUFF-TAN, FINE GRAINED, SUBANGULAR, POORLY SORTED. | 14.0 | | | |
| | | | | SS-PLUGGED/NO SAMPLE | | - |
| | | | 16.0 | | | |
| | | | | | | |
| | | | 18.0 | | | |
| | | | 20.0 | SS | | 1377 |
| | | | 22.0 | | | |
| | | | | | | |
| | | | 24.0 | | | |
| | | | 26.0 | SS | | 1775 |
| | SP | SAND: GRAY, FINE GRAINED, ANGULAR-SUBANGULAR, POORLY SORTED. | | | | |
| | | | 28.0 | | | |
| | | | 30.0 | SS | | 891 |
| | | | | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | | | | |
| | | EOB @ 37'. | 36.0 | SS | | 1188 |

TOTAL DEPTH: 37 FT
DRILLING DATE: 6-09-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 17.5 FEET

| FILE | ANCRB403.DWG |
|---|---|
| DATE | 5-2-94 KBW |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-5 (MW-3)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | | | 0.0 | NO SAMPLE | | - |
| | | | 2.0 | | | |
| | | | 4.0 | | | |
| | SP | SAND: TAN, MEDIUM GRAINED, ANGULAR-SUBANGULAR POORLY SORTED. | 6.0 | SS | | 0 |
| | | | 8.0 | | | |
| | | | 10.0 | SS-PLUGGED/NO SAMPLE | | 0 |
| | | | 12.0 | | | |
| | | | 14.0 | | | |
| | | SAND: GRAY, FINE GRAINED, SILTY, POORLY SORTED. | 16.0 | SS | | 0 |
| | SP | | 18.0 | | | |
| | | | 20.0 | SS | | 30 |
| | | EOB @ 22'. | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 22 FT
DRILLING DATE: 6-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 17.7 FEET

| FILE | ANCRB503.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-6 (MW-4)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | | | 0.0 | | | |
| | | | | NO SAMPLE-STARTED BORING W/ POSTHOLE DIGGER | | - |
| | | | 2.0 | | | |
| | | | 4.0 | | | |
| | | | | SS | | 0 |
| | | | 6.0 | | | |
| | SP | SAND: MED.BROWN, MEDIUM GRAINED, SUBANGULAR-SUBROUND POORLY SORTED. | 8.0 | | | |
| | | | 10.0 | SS | | 0 |
| | | | 12.0 | | | |
| | | | 14.0 | | | |
| | SP | SAND: GRAY, FINE GRAINED, SILTY, POORLY SORTED. | 16.0 | SS | | 3 |
| | | | 18.0 | | | |
| | | | 20.0 | SS | | 0 |
| | | | 22.0 | | | |
| | | EOB @ 22'. | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 22 FT
DRILLING DATE: 6-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 16.5 FEET

| FILE | ANCRB603.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-9

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | FILL | SAND: TAN-BROWN, ANGULAR-SUBANGULAR, SOME PEBBLES WELL SORTED. | 0.0 | SS | | 2 |
| | | | 2.0 | | | |
| | | | 4.0 | SS | | 0 |
| | | | 6.0 | | | |
| | | | 8.0 | SS | | 4 |
| | SP | SAND: TAN, FINE GRAINED, POORLY SORTED. | 10.0 | | | |
| | | | 12.0 | SS | | 2 |
| | | | 14.0 | | | |
| | | | 16.0 | SS | | 590 |
| | | | 18.0 | | | |
| | | | 20.0 | | | |
| | | EOB @ 22'. | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | | | |
| | | | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 22 FT
DRILLING DATE: 8-11-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 18 FEET

| FILE | ANCRB903.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-10 (MW-5)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | FILL | SAND: MEDIUM BROWN, MEDIUM GRAINED, GRANITE, ASPHALT | 0.0 | NO SAMPLE(OBSTRUCTION) | | |
| | | | 2.0 | SS | | 0 |
| | | | 4.0 | | | |
| | SW | SAND: MEDIUM BROWN, MEDIUM-COARSE GRAINED, SUBANGULAR, SOME PEBBLES 0.5-1CM WELL SORTED. | 6.0 | SS | | 0 |
| | | | 8.0 | | | |
| | | | 10.0 | SS | | 0 |
| | SP | SAND: TAN, FINE GRAINED, ANGULAR, POORLY SORTED. | 12.0 | | | |
| | | | 14.0 | | | |
| | SP | SAND: GRAY, FINE GRAINED, ANGULAR, OIL SHEEN, POORLY SORTED. | 16.0 | SS | | 1024 |
| | | | 18.0 | | | |
| | | | 20.0 | SS | | 1037 |
| | | | 22.0 | | | |
| | | | 24.0 | | | |
| | | | 26.0 | SS | | 924 |
| | | EOB @ 27'. | 28.0 | | | |
| | | | 30.0 | | | |
| | | | 32.0 | | | |
| | | | 34.0 | | | |
| | | | 36.0 | | | |

TOTAL DEPTH: 27 FT
DRILLING DATE: 8-11-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER: PAT BARR
DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 18 FEET

| FILE | ANRB1003.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-14 (MW-8)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | | (NOT SAMPLED SAME AS B-5) | 0.0<br>2.0<br>4.0<br>6.0<br>8.0<br>10.0<br>12.0<br>14.0<br>16.0<br>18.0<br>20.0<br>22.0<br>24.0 | | | |
| | SP | SAND: TAN-GRAY, FINE GRAINED,<br>6" RECOVERY<br>POORLY SORTED | 26.0 | NOT SAMPLED-<br>DRILLER OFF ON DEPTH | | |
| | | | 28.0<br>30.0 | GRAB | | 0 |
| | | | 32.0<br>34.0<br>36.0 | | | |

TOTAL DEPTH: 72 FT
DRILLING DATE: 8-13-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: MUD ROTARY

SOIL SAMPLING METHOD: GRAB

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT FEET

| FILE | ANR81403.DWG |
|---|---|
| DATE | 10-20-93 DLM |

# WENCK ASSOCIATES, INCORPORATED

## LOG OF SOIL BORING B-14 (MW-8)CONT.

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

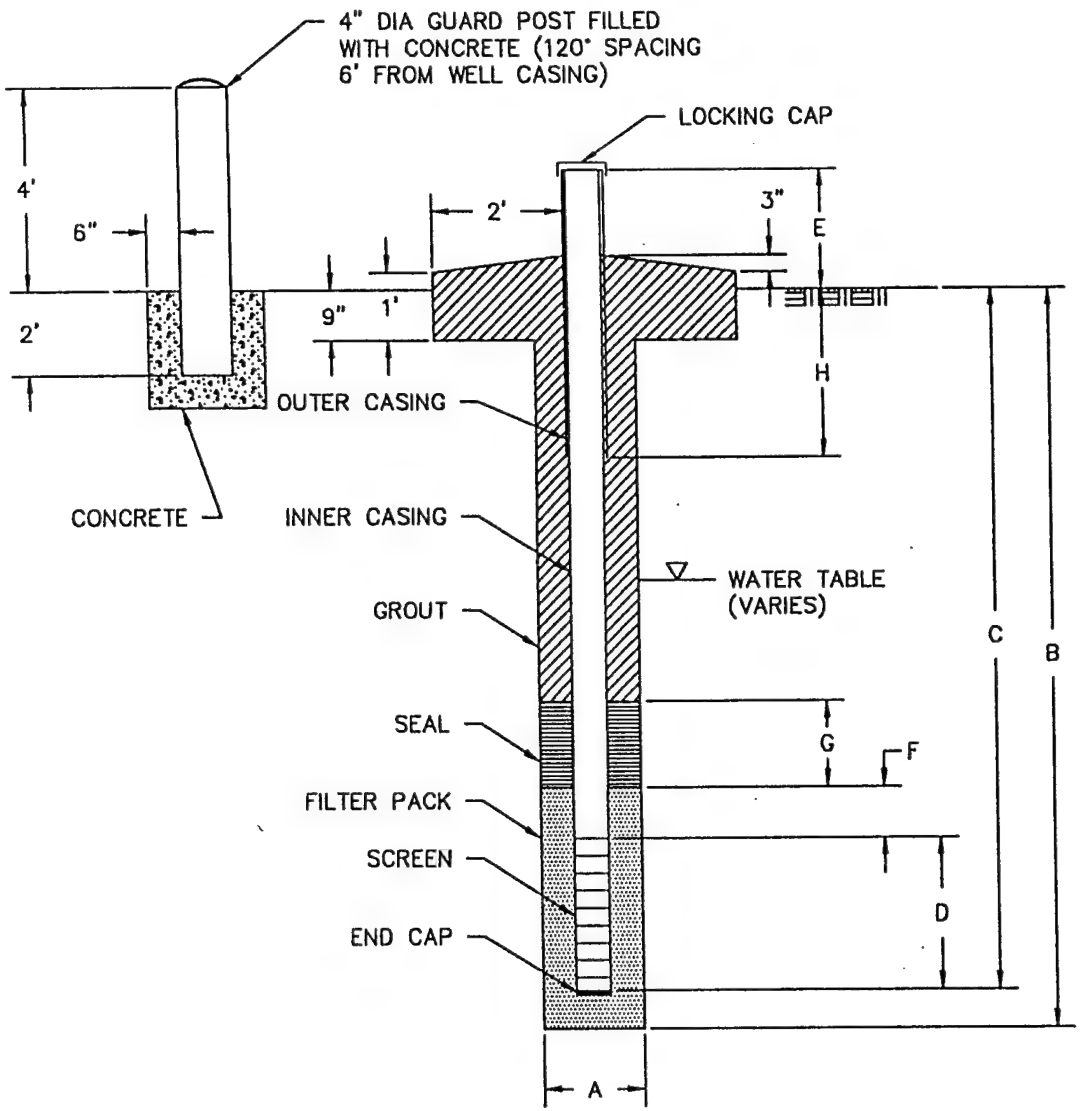
| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | |
|---|---|---|---|---|---|---|
| ELEV. (FT) | USCS GROUP | | DEPTH (FT) | SAMPLE TYPE | BLOW COUNT | HEADSPACE RESULTS (ppm) |
| | SP | SAME AS ABOVE | 36.0 | | | |
| | | | 38.0 | | | |
| | SW | SAND: TAN-GRAY, FINE-COARSE GRAINED, SUBANGULAR, WELL SORTED. | 40.0 | GRAB | | 0 |
| | | | 42.0 | | | |
| | | | 44.0 | | | |
| | | | 46.0 | | | |
| | | | 48.0 | | | |
| | SW | SAND: TAN-GREEN, MEDIUM-COARSE GRAINED, SUBANGULAR, WELL SORTED | 50.0 | GRAB | | 0 |
| | | | 52.0 | | | |
| | | | 54.0 | | | |
| | | | 56.0 | | | |
| | | | 58.0 | | | |
| | | | 60 | GRAB | | 0 |
| | | | 62.0 | | | |
| | | | 64.0 | | | |
| | | | 66.0 | | | |
| | | | 68.0 | | | |
| | CL | SAND: BROWN, SLIGHTLY SILTY, PLASTIC, FRAGMENTS | | GRAB | | - |
| | CL | SAND: GRAY, SILTY, PLASTIC, FRAGMENTS | 70.0 | GRAB | | - |
| | BR | BEDROCK: BLACK SCHIST, OBLONG FRAGMENTS | 72.0 | GRAB | | - |
| | | | | EOB @ 72'. | | |

TOTAL DEPTH: 72 FT
DRILLING DATE: 8-13-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: MUD ROTARY

SOIL SAMPLING METHOD: GRAB

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT FEET

| FILE | ANB14BC3.DWG |
|---|---|
| DATE | 10-20-93 DLM |




MONITORING WELL MW-2 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | |
| B | BOREHOLE DEPTH | 37 FEET |
| C | WELL DEPTH | 23.5 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 10 FEET |
| – | SCREEN DIAMETER | 2 INCHES |
| – | SLOT SIZE | 0.10 INCHES |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 13.5 TO 23.5 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCHES |
| – | CASING MATERIAL | PVC |
| E | STICK UP HEIGHT | 2 FEET |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| F | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |

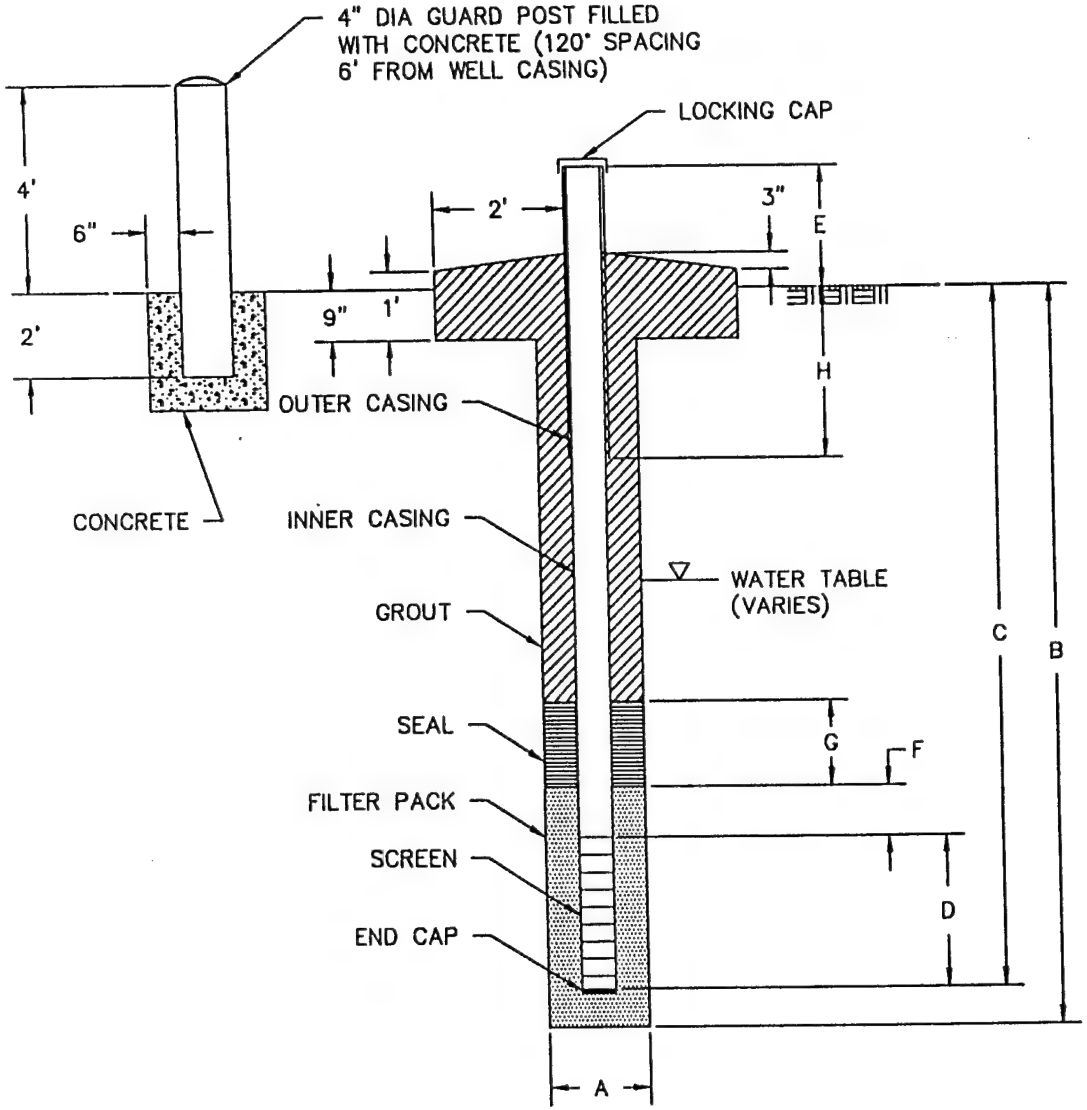
## OUTER CASING INFORMATION

| | | |
|---|---|---|
| H | CASING DEPTH | 4 FEET |
| – | CASING DIAMETER | 6 INCHES |
| – | CASING MATERIAL | STEEL |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | PORTLAND CONCRETE |
| – | DRILLING METHOD | -HSA |
| – | DRILLER | -TRAUT |
| – | INNER CASING ELEV. | -1151.97 FEET |
| – | DEPTH TO WATER | -17.5 FEET |
| – | DATE DRILLED | -6-09-93 |
| – | – | – |
| – | PROJECT NAME | -MNARNG |
| – | PROJECT LOCATION | -CAMP RIPLEY: BLDG. U-3 |

| | |
|---|---|
| FILE | ANRMW203.DWG |
| DATE | 10-20-93 DLM |




MONITORING WELL MW-3 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | |
| B | BOREHOLE DEPTH | 22 FEET |
| C | WELL DEPTH | 22 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 10 FEET |
| – | SCREEN DIAMETER | 2 INCHES |
| – | SLOT SIZE | 0.10 INCHES |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 12 TO 22 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCHES |
| – | CASING MATERIAL | PVC |
| E | STICK UP HEIGHT | 2.5 FEET |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| F | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |

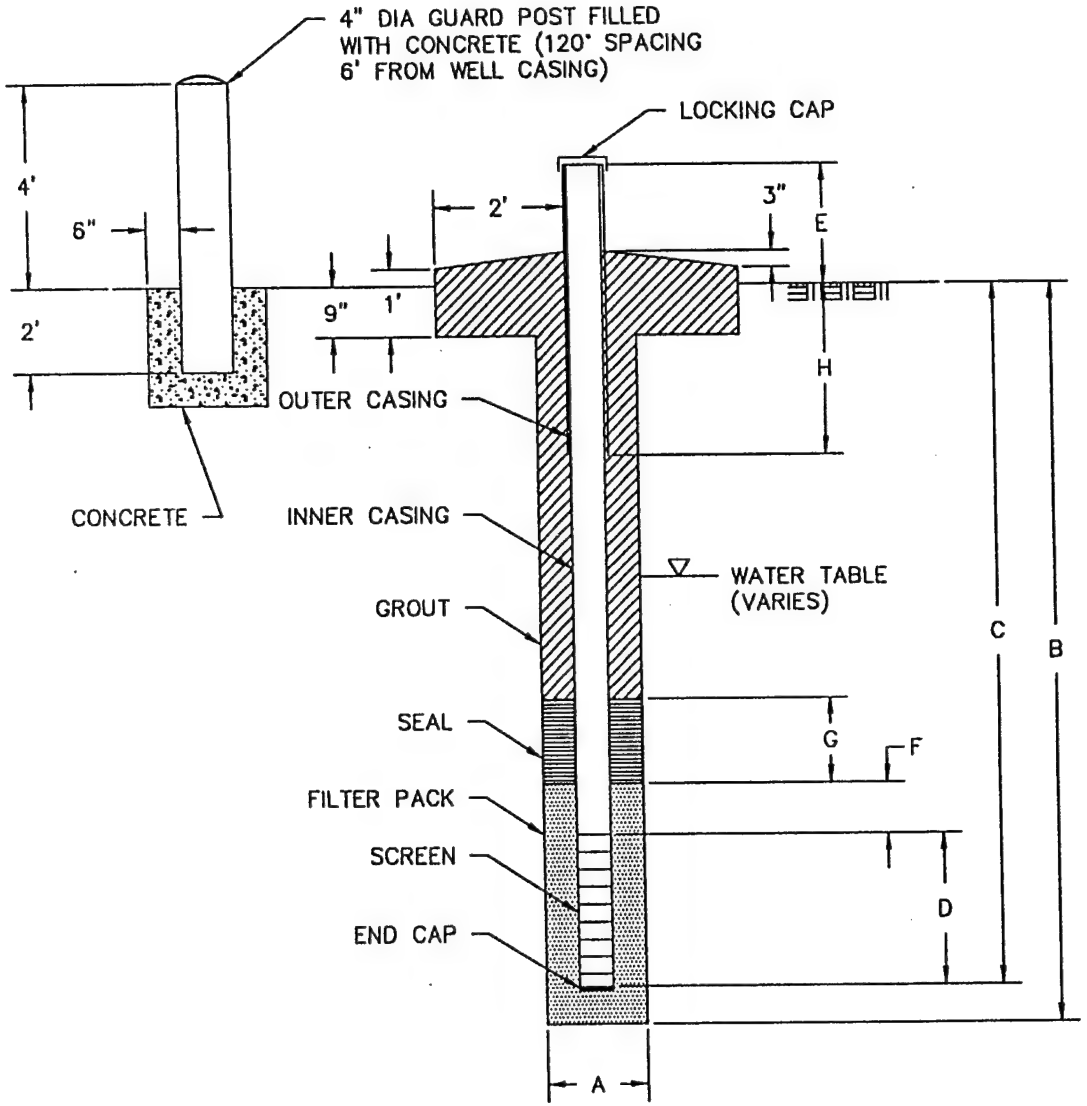
## OUTER CASING INFORMATION

| | | |
|---|---|---|
| H | CASING DEPTH | 4 FEET |
| – | CASING DIAMETER | 4 INCHES |
| – | CASING MATERIAL | STEEL |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | –PORTLAND CONCRETE |
| – | DRILLING METHOD | –HSA |
| – | DRILLER | –TRAUT |
| – | INNER CASING ELEV. | –1151.54 FEET |
| – | DEPTH TO WATER | –17.7 FEET |
| – | DATE DRILLED | –6–10–93 |
| – | – | – |
| – | PROJECT NAME | –MNARNG |
| – | PROJECT LOCATION | –CAMP RIPLEY: BLDG. U–3 |

| | |
|---|---|
| FILE | ANRMW303.DWG |
| DATE | 10–20–93 DLM |




MONITORING WELL MW-4 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | |
| B | BOREHOLE DEPTH | 22 FEET |
| C | WELL DEPTH | 22 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 10 FEET |
| – | SCREEN DIAMETER | 2 INCHES |
| – | SLOT SIZE | 0.10 INCHES |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 12 TO 22 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCHES |
| – | CASING MATERIAL | PVC |
| E | STICK UP HEIGHT | 2 FEET |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| F | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |

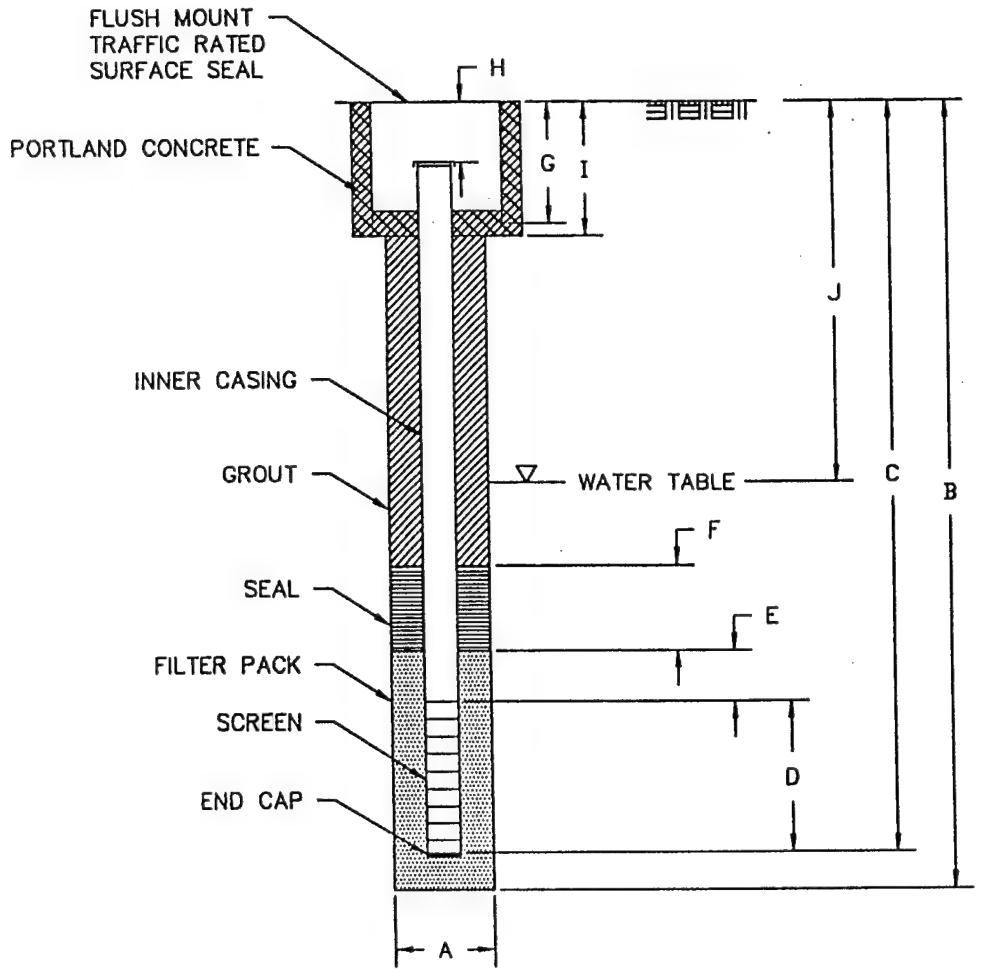
## OUTER CASING INFORMATION

| | | |
|---|---|---|
| H | CASING DEPTH | 4 FEET |
| – | CASING DIAMETER | 6 INCHES |
| – | CASING MATERIAL | STEEL |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | -PORTLAND CONCRETE |
| – | DRILLING METHOD | -HSA |
| – | DRILLER | -TRAUT |
| – | INNER CASING ELEV. | -1151.93 FEET |
| – | DEPTH TO WATER | -16.5 FEET |
| – | DATE DRILLED | -6-10-93 |
| – | - | - |
| – | PROJECT NAME | -MNARNG |
| – | PROJECT LOCATION | -CAMP RIPLEY: BLDG. U-3 |

| | |
|---|---|
| FILE | ANRMW403.DWG |
| DATE | 10-20-93 DLM |




## MONITORING WELL MW-5 SCHEMATIC

NOT TO SCALE

### BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | INCHES |
| B | BOREHOLE DEPTH | 27 FEET |
| C | WELL DEPTH | 23 FEET |

### SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 10 FEET |
| – | SCREEN DIAMETER | 2 INCH |
| – | SLOT SIZE | 0.010 INCH |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 13 TO 23 FEET |

### INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCH |
| – | CASING MATERIAL | PVC |

### FILTER PACK INFORMATION

| | | |
|---|---|---|
| E | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

### SEAL INFORMATION

| | | |
|---|---|---|
| F | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |

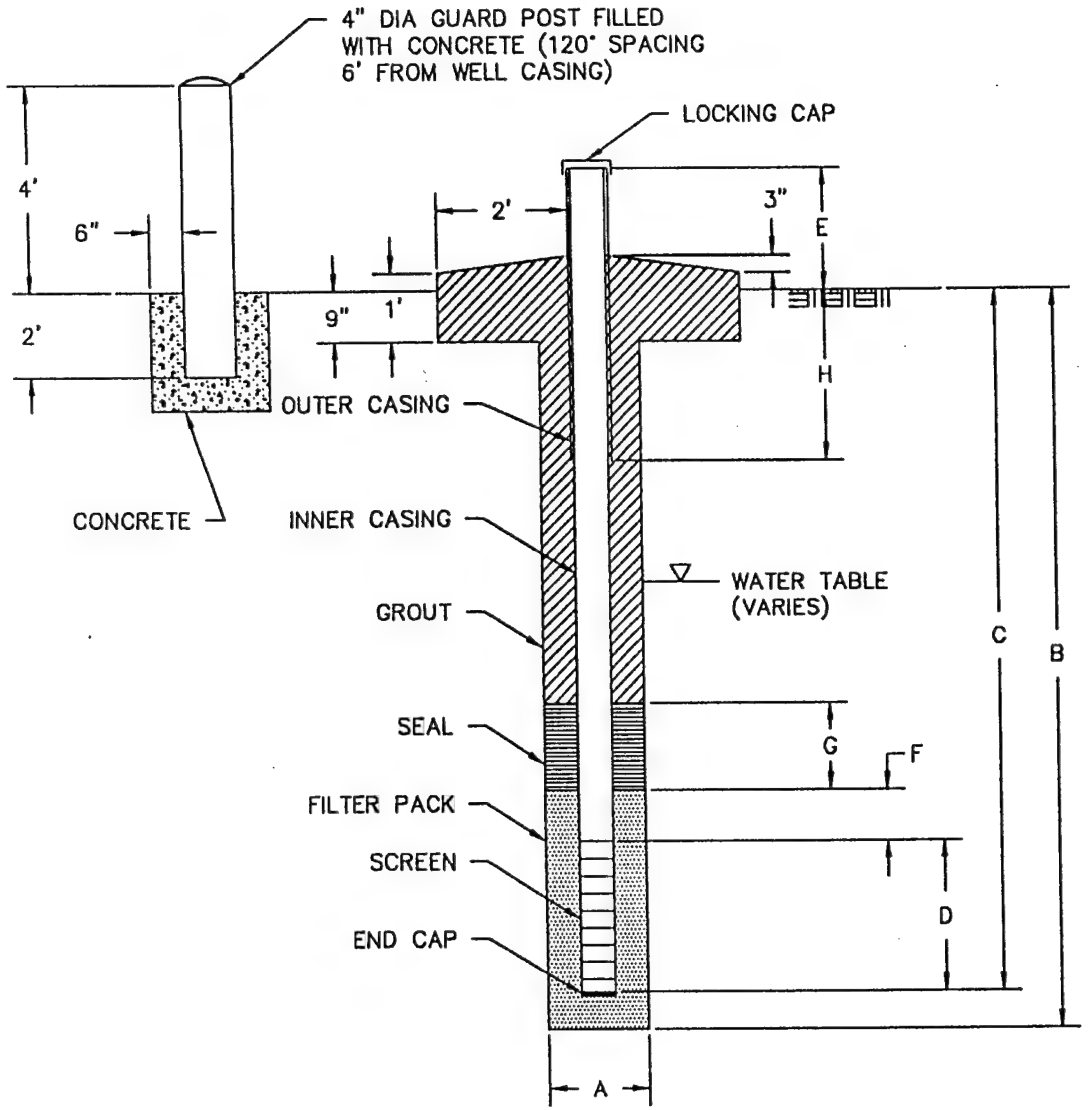
### SURFACE SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL DEPTH | 12 INCHES |
| – | SEAL DIAMETER | 8 INCHES |
| – | CASING MATERIAL | STEEL |
| H | INNER CASING DEPTH | INCHES |
| I | SURFACE EXCAVATION | 18 INCHES |

### OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | PORTLAND CONCRETE |
| – | DRILLING METHOD | HOLLOW STEM AUGER |
| – | DRILLER | PAT BARR/TRAUT |
| – | INNER CASING ELEVATION | 1148.58 |
| J | DEPTH TO WATER | APPROXMATELY 14 FEET |
| – | DATE DRILLED | 8-11-93 |
| – | – | – |
| – | – | – |
| – | PROJECT NAME | MNARNG |
| – | PROJECT LOCATION | CAMP RIPLEY BLDG.U-3 |

| | |
|---|---|
| FILE | ANRMW503.DWG |
| DATE | 10-20-93 DLM |




MONITORING WELL MW-8 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | |
| B | BOREHOLE DEPTH | 72 FEET |
| C | WELL DEPTH | 52 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 5 FEET |
| – | SCREEN DIAMETER | 2 INCHES |
| – | SLOT SIZE | 0.10 INCHES |
| – | MATERIAL | STAINLESS STEEL |
| – | SCREENED INTERVAL | 47 TO 52 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCHES |
| – | CASING MATERIAL | STEEL |
| E | STICK UP HEIGHT | 2 FEET |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| F | DIST. ABOVE SCREEN | 10 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |
| – | LOWER SEAL | BENTONITE SEAL: 64'-66' |

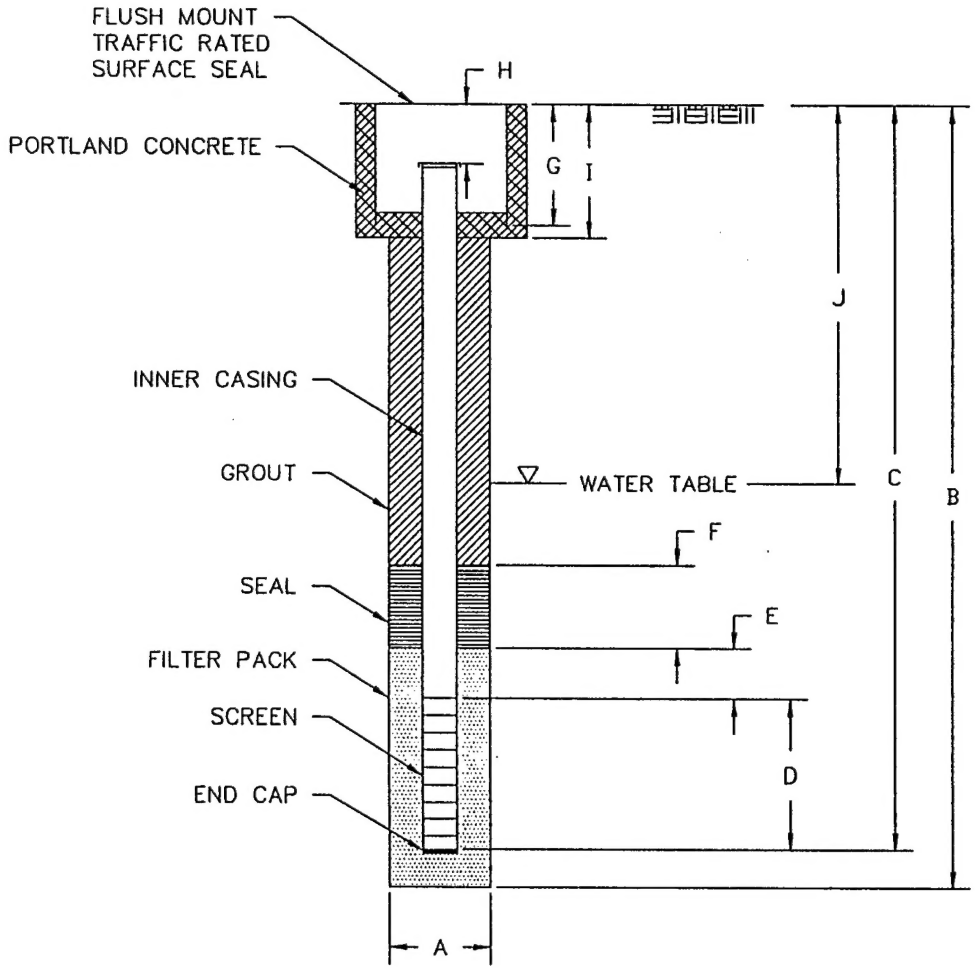
## OUTER CASING INFORMATION

| | | |
|---|---|---|
| H | CASING DEPTH | 4 FEET |
| – | CASING DIAMETER | 4 INCHES |
| – | CASING MATERIAL | STEEL |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | -PORTLAND CONCRETE |
| – | DRILLING METHOD | -HSA |
| – | DRILLER | -TRAUT |
| – | INNER CASING ELEV. | -1151.39 FEET |
| – | DEPTH TO WATER | -17 FEET |
| – | DATE DRILLED | -8-13-93 |
| – | - | - |
| – | PROJECT NAME | -MNARNG |
| – | PROJECT LOCATION | -CAMP RIPLEY: BLDG. U-3 |

| | |
|---|---|
| FILE | ANRMW803.DWG |
| DATE | 10-20-93 DLM |




EXTRACTION VENT EV-1 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | 6.25 INCHES |
| B | BOREHOLE DEPTH | 21 FEET |
| C | WELL DEPTH | 19 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 15 FEET |
| – | SCREEN DIAMETER | 4 INCH |
| – | SLOT SIZE | 0.010 INCH |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 4 TO 19 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 4 INCH |
| – | CASING MATERIAL | PVC |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| E | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| F | SEAL THICKNESS | 1 FOOT |
| – | SEAL MATERIAL | BENTONITE CHIPS |

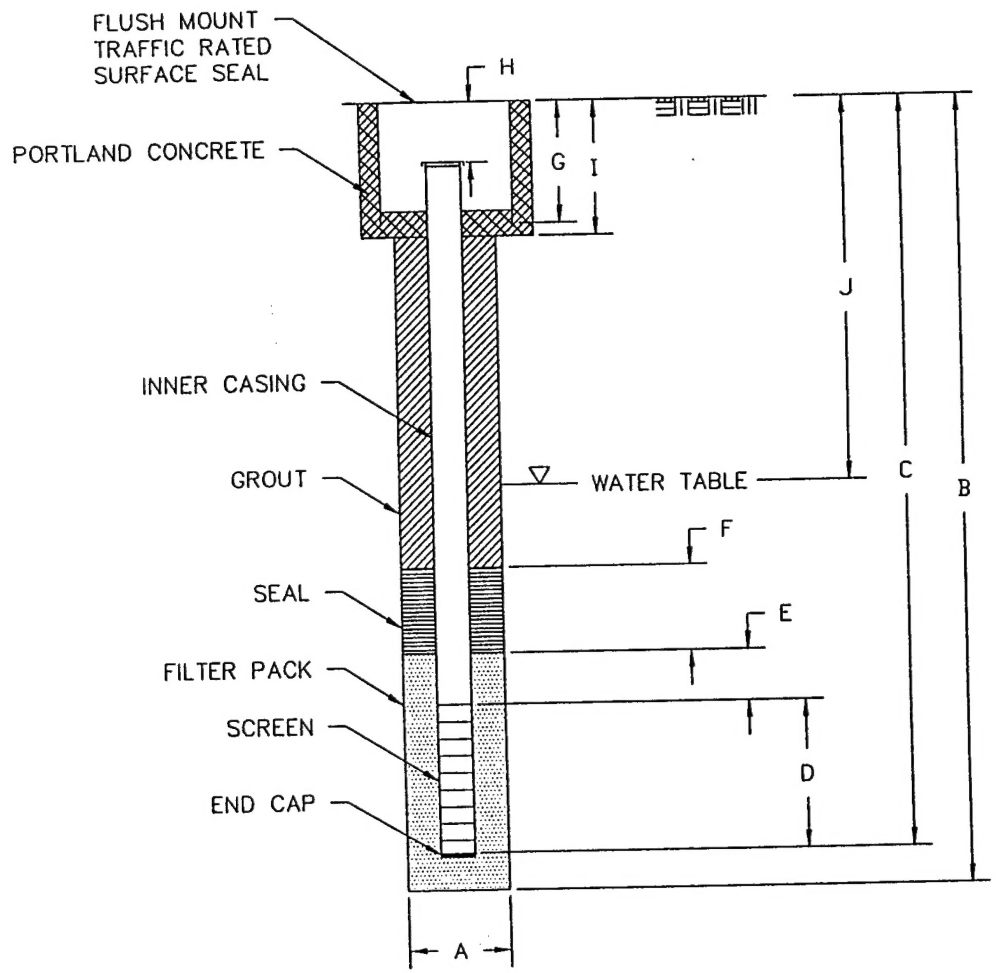
## SURFACE SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL DEPTH | 12 INCHES |
| – | SEAL DIAMETER | 24 INCHES |
| – | CASING MATERIAL | STEEL |
| H | INNER CASING DEPTH | 6 INCHES |
| I | SURFACE EXCAVATION | 18 INCHES |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | PORTLAND CONCRETE |
| – | DRILLING METHOD | HOLLOW STEM AUGER |
| – | DRILLER | TRAUT HYDROTECH |
| – | INNER CASING ELEVATION | N/A |
| J | DEPTH TO WATER | APPROXMATELY 16 FEET |
| – | DATE DRILLED | 3-3-94 |
| – | – | – |
| – | – | – |
| – | PROJECT NAME | MNARNG |
| – | PROJECT LOCATION | CAMP RIPLEY BLDG.U-3 |

| | |
|---|---|
| FILE | MNNGEV1.DWG |
| DATE | 04-19-94 DLM |




## MONITORING VENT MV-1 SCHEMATIC

NOT TO SCALE

## BOREHOLE INFORMATION

| | | |
|---|---|---|
| A | BOREHOLE DIAMETER | 4.25 INCHES |
| B | BOREHOLE DEPTH | 22 FEET |
| C | WELL DEPTH | 22 FEET |

## SCREEN INFORMATION

| | | |
|---|---|---|
| D | SCREEN LENGTH | 12 FEET |
| – | SCREEN DIAMETER | 2 INCH |
| – | SLOT SIZE | 0.010 INCH |
| – | MATERIAL | PVC |
| – | SCREENED INTERVAL | 10 TO 22 FEET |

## INNER CASING INFORMATION

| | | |
|---|---|---|
| – | CASING DIAMETER | 2 INCH |
| – | CASING MATERIAL | PVC |

## FILTER PACK INFORMATION

| | | |
|---|---|---|
| E | DIST. ABOVE SCREEN | 2 FEET |
| – | FILTER PACK MATERIAL | # 30 RED FLINT SAND |

## SEAL INFORMATION

| | | |
|---|---|---|
| F | SEAL THICKNESS | 2 FEET |
| – | SEAL MATERIAL | BENTONITE CHIPS |

## SURFACE SEAL INFORMATION

| | | |
|---|---|---|
| G | SEAL DEPTH | 12 INCHES |
| – | SEAL DIAMETER | 24 INCHES |
| – | CASING MATERIAL | STEEL |
| H | INNER CASING DEPTH | 6 INCHES |
| I | SURFACE EXCAVATION | 18 INCHES |

## OTHER INFORMATION

| | | |
|---|---|---|
| – | GROUT MATERIAL | NEAT CEMENT |
| – | SURFACE SEAL | PORTLAND CONCRETE |
| – | DRILLING METHOD | HOLLOW STEM AUGER |
| – | DRILLER | TRAUT HYDROTECH |
| – | INNER CASING ELEVATION | N/A |
| J | DEPTH TO WATER | APPROXMATELY 17 FEET |
| – | DATE DRILLED | 3-3-94 |
| – | – | – |
| – | – | – |
| – | PROJECT NAME | MNARNG |
| – | PROJECT LOCATION | CAMP RIPLEY BLDG.U-3 |

| | |
|---|---|
| FILE | MNNGMV1.DWG |
| DATE | 04-19-94 DLM |

# ATTACHMENT C

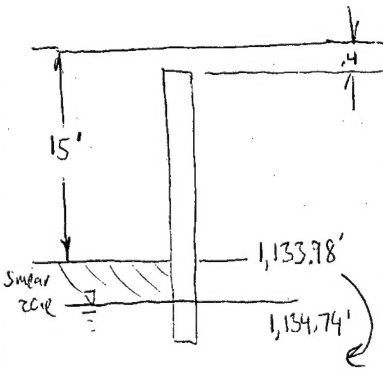
# GROUNDWATER ELEVATIONS AND ESTIMATED "SMEAR ZONE" ELEVATION

Bldg U-3 Camp Ripley

GROUND WATER ELEVATION

| WELL # | 23 NOV 93 | 27 OCT 94 | 26 JAN 95 | 20 APR 95 | 19 JUL 95 | 1 MAR 96 |
|---|---|---|---|---|---|---|
| MW #1 | 1134.00 | 1135.80 | 1134.92 | 1135.17 | 1136.40 | 1135.03 |
| → MW #3 | 1133.63 | 1135.28 | 1134.40 | 1134.70 | 1135.89 | 1134.57 |
| → MW #4 | 1133.44 | 1135.34 | 1134.49 | 1134.75 | 1135.97 | 1134.63 |
| → MW #5 | 1133.67 | 1135.46 | 1134.54 | 1134.76 | 1135.99 | 1134.74 |
| MW #6 | 1132.91 | 1135.12 | 1134.32 | 1134.62 | 1135.81 | 1133.52 |
| MW #2 | 1133.92 | | | | 1136.16 | |
| MW #7 | 1133.09 | | | | 1135.85 | |
| MW #8 | 1133.50 | | | | 1135.94 | |
| MW #9 | 1132.27 | | | | 1135.09 | |
| MW #10 | 1132.53 | | | | 1135.17 | |

MW-5:

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To Craig Snyder | From Larry Rainey

Co./Dept. | Co. MN NKNG

Phone # | Phone #

Fax # (303) 831-8208 | Fax # 320-632-7473

Notes by John Ratz on 4-26-96:

| Well | Groundwater Elevation on 1 March 1996 (ft) | Inner Casing Elevation (ft) | Distance from top of Inner Casing to Ground (ft) | Distance from ground to top of "Smear Zone" | Smear Zone Above GW Table |
|---|---|---|---|---|---|
| MW-3 (stickup) | 1,134.57 | 1,151.54 | 2.5 | NA, clean hole | - |
| MW-4 (stickup) | 1,134.63 | 1,151.93 | 2 | NA, Clean hole | - |
| MW-5 (stickup) | 1,134.74 | 1,148.58 | -.4 feet (approximate) | 15' | 0 |

∴ Smear zone at MW-5 begins at approximately 1,134.0 feet above msl (top of smear zone). Therefore, the smear zone has been entirely underwater since 23 Nov 93, when only about a 4" thickness was above groundwater (and even much of this section was likely saturated given capillary action). No contamination exists in the vadose zone, so bioventing/SVE is inappropriate.